Notice of Allowability	Application No.	Applicant(s)
	10/080,730	PETROPOULOS ET AL.
	Examiner	Art Unit
	Tiffany A Fetzner	2859

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *02/17/2004 and the telephone interviews of March 12th, 15th, 16th & 17th 2004*.

2. ☒ The allowed claim(s) is/are *1-12 and 14-20*.

3. ☐ The drawings filed on _____ are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☒ to Paper No./Mail Date *7*.
   (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date *03/17/20*.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date *03/18/2004* .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

2. Authorization for this examiner's amendment was given in a telephone interview with **Evan R. Sotiriou Reg. No. 46,247** on March 17th 2004. The application has been amended as follows:

In the Specification

A) On page 38, line 8 **delete** "implement" and **insert** "implemented".

B) On page 38, line 22 **delete** "grater" and **insert** "greater".

In the Claims submitted with **the RCE request of February 17th 2004**:

A) **Replace claim 1,** with the following **examiner amended claim 1,** "

-- **Claim 1.** An open MRI gradient coil set for imaging an object, said coil set comprising:

a uniplanar Z-gradient coil configured to extend along the longitudinal axis of an object;

a biplanar X-gradient coil extending perpendicularly to said uniplanar Z-gradient coil in each of a first plane and a second plane; and

a biplanar Y-gradient coil extending perpendicularly to said uniplanar Z-gradient coil in each of the first plane and the second plane, the first plane and the second plane being generally parallel to one another and separated by a gap, wherein said coils are

configured to allow insertion of at least a portion of the object in the gap between the first plane and the second plane having said biplanar X-gradient and Y-gradient coils, and said coil set together forming an open Z-axis face opposite said Z-gradient coil, said open Z-axis face extending the length of the longitudinal axis. --

B) **Replace claim 5,** with the following **examiner amended claim 5,**

-- **Claim 5.** A coil set according to claim 1, further comprising a radio frequency coil integrated within the gap. --

C) **Replace claim 9,** with the following **examiner amended claim 9,**

-- **Claim 9.** A coil set according to claim 1, wherein the open Z-axis face is configured to allow a non-disrupted view by a human subject, during imaging of the human subject. --

D) **Replace claim 12,** with the following **examiner amended claim 12,**

-- **Claim 12.** An insertable open gradient coil set for magnetic resonance imaging, said gradient coil set comprising:

a Z-gradient coil positioned substantially in parallel with the main magnet poles of a magnetic resonance imaging system and configured to be positioned along a **length** of an object being imaged;

an X-gradient coil positioned substantially perpendicular to the main magnet poles, said X-gradient coil configured in perpendicular arrangement to said Z-gradient coil and configured to be positioned along each of a first side and a second side of the object; and

a Y-gradient coil configured in a biplanar arrangement with said X-gradient coil, said Y-gradient coil configured in perpendicular arrangement to said Z-gradient coil and configured to be positioned along each of the first side and the second side of the object, the first side and the second side having said X-gradient and Y-gradient coils defining a gap therebetween configured to allow insertion of at least a portion of the object, said coils forming a unitary construction having a Z-axis opening opposite said Z-gradient coil and configured to extend along the length of the object being imaged, the unitary construction being insertable within the magnetic resonance imaging system. --

E) Cancel claim 13.

F) Replace claim 14, with the following **examiner amended claim 14,**

-- **Claim 14.** A coil set according to claim 12, wherein said object is a patient, said X-gradient and Y-gradient coils each comprise a parabolic cut-off, and wherein said parabolic cut-offs are configured to receive the shoulders of the patient. --

G) Replace claim 15, with the following **examiner amended claim 15,**

-- **Claim 15.** A coil set according to claim 14, wherein said parabolic cut-offs are configured in a symmetric arrangement and positioned at a lower end of each of the X-gradient coil and Y-gradient coil. --

H) Replace claim 16, with the following **examiner amended claim 16,**

-- **Claim 16.** A coil set according to claim 12, wherein the open Z-axis face is configured to allow a non-disrupted view by a human subject, during imaging of the human subject. --

I) Replace claim 17, with the following **examiner amended claim 17,**

-- **Claim 17.** A coil set according to claim 12, further comprising at least one set of additional gradient coils in combination with at least one of said X-gradient, Y-gradient, and Z-gradient coils, together forming an array configured to extend imaging coverage of the coil set. --

J) **Replace claim 18,** with the following **examiner amended claim 18,**

-- **Claim 18.** A coil set according to claim 12, wherein said gradient coils are configured to operate in connection with the magnetic resonance imaging system to image at least one of a head, knee, upper thigh and foot of the object. --

K) **Replace claim 19,** with the following **examiner amended claim 19,**

-- **Claim 19.** A method for magnetic resonance imaging, said method comprising:

configuring a Z-gradient coil to extend along the longitudinal axis of an object and substantially perpendicular to a pair of biplanar X-gradient and Y-gradient coils; and

configuring said biplanar X-gradient and Y-gradient coils in a parallel arrangement , said biplanar X-gradient and Y-gradient coils each extending in each of a first plane and a second plane substantially perpendicular to said Z-gradient coil and spaced apart to allow insertion therebetween of at least a portion of the object, said coils together forming a Z-axis opening opposite said Z-gradient coil, said Z-axis opening extending the length of the longitudinal axis. --

L) **Replace claim 20,** with the following **examiner amended claim 20,**

-- **Claim 20.** A method according to claim 19, wherein the object is a patient, and further comprising a parabolic cut-off in each of the X-gradient and Y-gradient coils to receive the shoulders of the patient. --

Examiner's Amendment to the Formal drawings submitted December 19th 2003

3. The following changes to the drawings have been approved by the examiner and agreed upon by applicant:

A) Applicant will submit a replacement set of all Formal drawings, (i.e. Figures 1 through 19) including the Figures identified as figures 13, and 14 which were missing from the December 19th 2003 submission, and the identification of the figure below figure 15, from the December 19th 2003 submission, as figure 16.

B) The examiner notes that the inclusion of the missing figures is necessary because these figures are present in applicant's original disclosure. The examiner approved changes, (i.e. the inclusion of figures 13 through 16 as part of the Formal drawing set) are attached to the back of this office action.

4. In order to avoid abandonment of the application, applicant must submit an entire new set of FORMAL drawings including the figures that were originally omitted, or missing an identification label, and include: the proposed drawing corrections submitted July 15th 2003, which:

A) eliminates/cancels originally filed Figures 2a, 2b, 3, 4, 8, and 14 which initially were just columns of numerical data, without any specification, (i.e. a heading, table, legend, or key) to identify what the data represents, or to which coil configuration(s) the data was related, have been approved by the examiner.

B) The renumbering of the remaining figures and the correction of all reference numbers, within the specification, that have been impacted by the correction of the figure numbering which have also been approved by the examiner.

C) The New Formal drawings, for all figures which include each of the red-ink approved changes are needed in response to this office action.

Examiner's Comment

5. Support for each of the examiner's Amendments to **claims 1, 5, 9,** and **12-20** come from applicant's **Figures 1** and **13-20**. No new matter was added.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Response to Arguments

7. Applicant's arguments filed February 17th 2004 have been fully considered but they are not persuasive, because the February 17th 2004 amended claims fail to distinguish over the prior art of record. However, in response to the telephonic interviews with the examiner concerning the structure and geometrical arrangement of applicant's invention, of March 15th 16th, and 17th 2004, and the permission given by applicant's representative for the examiner to make an Examiner's Amendment to the specification, drawings, and claims 1, 5, 9, and 12 through 20, to ensure that the structures shown in figures 1 and 13 through 19 are claimed, all of the previous grounds of rejection are withdrawn,

The following is an examiner's statement of **Reasons for Allowance**:

8. With respect to **Examiner Amended Independent Claim 1**, "An open MRI gradient coil set for imaging an object, said coil set comprising:

a uniplanar Z-gradient coil configured to extend along the longitudinal axis of an object;

a biplanar X-gradient coil extending perpendicularly to said uniplanar Z-gradient coil in each of a first plane and a second plane; and

a biplanar Y-gradient coil extending perpendicularly to said uniplanar Z-gradient coil in each of the first plane and the second plane, the first plane and the second plane being generally parallel to one another and separated by a gap, wherein said coils are configured to allow insertion of at least a portion of the object in the gap between the first plane and the second plane having said biplanar X-gradient and Y-gradient coils, and said coil set together forming an open Z-axis face opposite said Z-gradient coil, said open Z-axis face extending the length of the longitudinal axis."

9. **Examiner Amended Independent Claim 12**, ""An insertable open gradient coil set for magnetic resonance imaging, said gradient coil set comprising:

a Z-gradient coil positioned substantially in parallel with the main magnet poles of a magnetic resonance imaging system and configured to be positioned along a **length** of an object being imaged;

an X-gradient coil positioned substantially perpendicular to the main magnet poles, said X-gradient coil configured in perpendicular arrangement to said Z-gradient coil and configured to be positioned along each of a first side and a second side of the object; and

a Y-gradient coil configured in a biplanar arrangement with said X-gradient coil, said Y-gradient coil configured in perpendicular arrangement to said Z-gradient coil and configured to be positioned along each of the first side and the second side of the object, the first side and the second side having said X-gradient and Y-gradient coils defining a gap therebetween configured to allow insertion of at least a portion of the object, said coils forming a unitary construction having a Z-axis opening opposite said Z-gradient coil and configured to extend along the length of the object being imaged, the unitary construction being insertable within the magnetic resonance imaging system."

10. **Examiner amended claim 19,** "A method for magnetic resonance imaging, said method comprising:

configuring a Z-gradient coil to extend along the longitudinal axis of an object and substantially perpendicular to a pair of biplanar X-gradient and Y-gradient coils; and

configuring said biplanar X-gradient and Y-gradient coils in a parallel arrangement , said biplanar X-gradient and Y-gradient coils each extending in each of a first plane and a second plane substantially perpendicular to said Z-gradient coil and spaced apart to allow insertion therebetween of at least a portion of the object, said coils together forming a Z-axis opening opposite said Z-gradient coil, said Z-axis opening extending the length of the longitudinal axis."

11. These Examiner amended claims are considered to be allowable over the **prior art of record** because each of these claims contains a novel and non-obvious combinational configuration of open architecture MRI gradient coils, that is not taught, shown, or suggested by the prior art of record. It is the combinational arrangement and configuration of the coil components taken as a whole that is the feature of novelty in each of applicant's independent claims, and it is this feature that distinguishes applicant's application from the prior art.

12. The prior arts of **Lampman et al., Boskamp et al., Petropoulos, Petropoulos et al.,** [See the US patents and articles from applicant's IDS statement of June 11th 2002, with the 1449 form scanned April 10th 2003] **Cho et al., Takeshima, Pausch, Sementchenko,** and **Roemer** do not teach, suggest, or show an open MRI gradient coil set/configuration as set forth by applicant. It would not have been obvious to one of ordinary skill in the art, at the time that the invention was made to alter the MRI gradient coil sets of the prior art because in the prior art the open design of applicant's gradient coils shown in figures 1 and 13 through 19 of applicant's specification is unknown, and cannot be constructed from the prior art without destroying the configurations found within the prior art. Applicant's open gradient coil set / configuration teaches away from what is known in the art, and is therefore considered to be both novel and nonobvious by the examiner.

13. With respect to **dependent claims 2-11**, which depend from **examiner amended independent claim 1**, **dependent claims 14-18**, which depend from **examiner amended independent claim 12**and **dependent claim 20**, which depends

from **examiner amended independent claim 19,** each of these **dependent claims** are considered to be allowable by the examiner because they depend from an allowable **examiner amended independent claim**, therefore the same reasons for allowance, novelty and nonobviousness, that apply to **examiner amended independent claims 1**, **12** and **19** also apply to **Dependent claims** 2-**11, 14-18**, and **20**, and need not be reiterated.

14. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Prior Art made of Record

15. The **prior art made** of **record** and not relied upon is considered pertinent to applicant's disclosure.

A) Lampman et al., US patent 5,497,089 issued March 5th 1996.

B) Boskamp et al., US patent 6,563,315 B1 issued May 13th 2003, filed June 6th 2001. This reference shows a biplanar gradient coil configuration but the configuration of **Boskamp et al.,** does not meet the requirements set forth in applicant's Examiner amended claims, because **Boskamp et al.,** does not show or teach a uniplanar gradient coil in combination with the biplanar coils that meet the requirements set forth in applicant's Examiner amended claims.

C) Bushong, Stewart C. Magnetic Resonance Imaging Physical and Biological Principles Second Edition. Textbook 1996 pages 146, 147 and 152-155, which show the

RF coils of Figures 1 and 13-19 in applicant's Figures. The examiner notes that applicant's invention concerns a novel configuration of gradient coils, that are used with conventional RF coils, like the ones shown by **Stewart C. Bushong.**

Conclusion

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

17. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(703) 872-9306**.

TAF
March 18, 2004

Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800